FORCE LIMIT SPECIFICATIONS VS. DESIGN LIMIT LOADS IN VIBRATION TESTING

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ABSTRACT

Flight equipment is exposed to random vibration excitations during launch and is functionally designed to survive a shaker random vibration testing. In the testing, the random vibration design levels will be applied at the equipment-mounting interface and will be force limited to reduce over-testing at shaker hardmount resonance frequencies. As known, response of equipment also is designed to the structural flight limit load. The philosophy of the limited load factors (LLFs) or so-called the Mass Acceleration Curve (MAC) has been adopted over many years for use in the preliminary structural design of spacecraft and flight equipment. The work presented here is to discuss the result of forces limited notching during vibration testing with respect to the traditional limit load design criteria. By using a single-degree-of-freedom (SDOF) system approach, it shows that with an appropriate force specification the notched response due to force limiting will result in loads comparable with the structural design limit criteria. Enclosed is a simplified formula to predict the test load limits, based only upon estimates for the first significant resonance of the equipment and the semi-empirical force factor, C^2. The work is current being applied to include two or multi-degree-of-freedom vibratory systems.